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ABSTRACT

A two-year project was funded at the Community College of Allegheny County to develop a model strategy for eliminating math anxiety and increasing basic mathematics skills in women students. Part of the rationale for the project was to combat the sex-role stereotypes that have traditionally tracked women away from math- and/or science-oriented careers. The model employed a five-week series of Mathophobia Workshops in which students developed prerequisite math competencies through success-oriented instruction and identified and practiced personal strategies in handling math anxiety. Workshop personnel included the Director of the Learning Center; a professional counselor who provided group feedback, career information, and test interpretation; two math instructors who developed individualized and group learning strategies; a psychology instructor who provided deconditioning exercises; a paraprofessional counselor/tutor; and peer tutors. Two-thirds of the workshop time was devoted to math instruction, including product-related topics such as fractions and decimals, and process-related topics such as non-computational problem-solving and "hands-on" experience with abaci and calculators. Counseling strategies were designed to identify math anxiety, encourage the sharing of problems, and promote continued group support after the end of the workshops. A bibliography of instructional materials is included. (JP)

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THE MATHOPHOBIA WORKSHOP: A STRATEGY FOR DEVELOPING MATHEMATICAL READINESS FOR THE ACADEMICALLY DISADVANTAGED STUDENT IN CAREER EDUCATION

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THE MATHOPHOBIA WORKSHOP: A STRATEGY FOR DEVELOPING MATHEMATICAL READINESS FOR THE ACADEMICALLY DISADVANTAGED STUDENT IN CAREER EDUCATION*

A. HISTORICAL BACKGROUND

A pilot study was implemented at Boyce Campus (Community College of Allegheny County) in the fall 1976-77 term, to investigate remedies for decreasing fear of math and increasing mathematical skills in women. The data gathered from this experimental program indicated that not only did fear of math decrease and computational skills increase, but that the women involved expanded their career choices to include training for programs not traditionally selected by women, e.g., Banking and Finance, Computer Programming and Administration of Justice.

The success of the pilot program prompted the funding of a two-year project by the Pennsylvania State Vocational Education Department (funded under Subpart 2, Academically Disadvantaged: Higher Education). The general purpose was the development and implementation of a model strategy focusing upon academically disadvantaged students, especially women, who lack the basic prerequisite mathematical skills necessary for successful performance in a variety of career/vocational education programs traditionally closed to such students at the post-secondary level. In addition, a unified effort was made to coordinate the expertise of a comprehensive team of personnel capable of diagnosis, prescription, and treatment of both the anxieties and the incompetencies associated with the Mathophobia Syndrome.

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* Funded under grants from the Commonwealth of Pennsylvania, Department of Education, (Vocational Education Department) Project Numbers: 72-8109 (1977-78), 71-9024 (1978-79), P.L. 94-482.

B. RATIONALE

Dissatisfaction with the milieu surrounding career opportunities available is quite apparent in today's society. Schools have systematically encouraged selected students, especially women, to enroll in certain career courses only, usually excluding those requiring a math and/or science background. Society, too, has discouraged the entrance of women into many career areas. This process has tended to channel students into a limited number of careers: "people oriented careers." Yet, students, in many cases, are their own greatest obstacle to expanding career opportunities and options because of their long-held attitudes and values. Assistance must be provided to reverse this trend and to remediate this academic disadvantage.

Increasingly in literature, both popular and professional, there is a concern with sexism or "occupational segregation," the tracking of women into 'soft' fields. What many writers and educators are increasingly concerned with is the avoidance of careers based on math. Experiences which will assist women to alter their attitudes and to increase their skills must be provided.

Students entering the community college are seeking alternative planning for their present life styles, planning devoid of sex-role stereotyping which says women are incapable of developing mathematical skills, therefore, limited in terms of vocational-technical career choices and prerequisite training programs, i.e., educational equity. The cost to society of providing educational guidance and career programs which are suited to neither student needs or societal needs are tremendously high. Experiences must be provided which allow individuals to become contributing members of society and to eradicate sex bias and the resulting academic disadvantage in both the career education and career aspirations of students.

Studies and programs have developed in all areas of the country indicating the national recognition of both the scope of student needs and the impact of math anxiety on large student populations. Thus, there is ample evidence of the need to

create appropriate opportunities for women to identify, define, confront, and ultimately overcome the fear of math.

Therefore, a Mathophobia Workshop strategy was developed and implemented for the academically disadvantaged who lack the basic prerequisite mathematical skills necessary for successful performance in a variety of career/vocational education programs traditionally closed to women at the post/secondary level. The approach involved the utilization of a workshop model designed to meet the needs of students in terms of eliminating sex role stereotyping as it effects the performance and choices of students, especially women, in science/math oriented curricular/career areas. The implementation of this strategy has resulted in a unified institutional approach to the task of educational equity for academically disadvantaged women involving the cooperative efforts of administrators, instructional staff, Learning Center staff, counselors, and community personnel.

In essence, an educational program has been designed for the expansion of career choices and opportunities traditionally closed to women because sex role socialization has created a fear of math, i.e., "mathophobia", preventing the development of sufficient levels of mathematical competency needed for success in a wide range of USOE Career Clusters. Thus, the focus was upon the design, implementation and dissemination of activities involving the following components:

The Student Component - The participation in a pre-designed series of structured mathophobia workshops and the identification of characteristics of "mathophobia" in terms of academic disadvantagement of women in post-secondary vocational/career educational programs.

The Staff Component - The design, implementation, and evaluation of a treatment strategy for the female "mathophobia" student through cooperative efforts of instructional, Learning Center, and counseling personnel.

The preliminary data do indicate that not only did fear of math decrease, as measured on the MARS, and computational skills increase, as measured on the BSST, but that students involved have expanded their career choices to include training for programs not traditionally selected by mathophobic individuals.

C. PERSONNEL

The Workshop staff included the Director of the Learning Center, a professional counselor, two math instructors, a psychology instructor, a paraprofessional counselor/tutor, and student tutors as needed. This particular combination of personnel was selected to provide functional unity of the specific skills each brought to the situation. Thus, a composite strategy was designed vital to the facilitation of educational equity as related to the math anxiety syndrome.

The Director of the Learning Center served as the project initiator and administrative coordinator. The professional counselor provided group feedback to participants and staff, career information resources and test interpretation. One math instructor designed reception learning experiences utilizing an individualized textbook related approach. (See description of Type One strategies discussed below.) The second math instructor designed discovery learning experiences utilizing a group related approach. (See description of Type Two strategies discussed below.) The psychology instructor utilized his expertise for implementation of desensitizing and deconditioning processes, data collection for research design and administration of the pre-post testing program. The paraprofessional counselor/tutor was a community person (non-student) who worked with both math instructors and the counselor to assist workshop participants with the communication of individual concerns while in process. Peer tutors provided necessary tutorial assistance to workshop participants on a need basis.

D. STRATEGY

The "Mathophobia" program was composed of a series of readiness workshops designed to alleviate anxieties associated with mathematics. The workshops were conducted over a five-week time span and met three days each week for two hours. Two-thirds of the time was spent in math-related experiences and the remaining one-third in counseling-oriented experiences. Thus, an effort was made to remediate incompetencies in math through the design and implementation of success-oriented math instructional strategies and to identify and practice personal strategies for handling the anxiety associated with math instructional experiences.

Type One Math Strategies - Type One math instructional strategies were based on an analysis of participant performance on the BSST (See Appendix B). The results of this test were used to implement a diagnostic/prescriptive reception learning environment. Lectures and materials were selected by the instructor and paraprofessional counselor/tutor on the basis of assuring student success. Formal lectures were given to the whole group and specific applications were provided on an individualized basis determined by each participant's needs and and progress in terms of specific mathematical competencies. Often every student was utilizing different instructional materials with the assistance of the instructor and other staff personnel. Primarily the topics covered in lectures included: systems of numeration, fractions, decimals and word problem solving strategies.

Type Two Math Strategies - Type Two math strategies consisted of guided-discovery learning experiences designed to focus upon the processes as opposed to the products of mathematics. During problem solving sessions, participants were provided with problems involving no computation and divergent solution strategies arrived at through logical reasoning and/or trial and error. To reinforce the divergent as opposed to the convergent nature of mathematics,

activities were designed to permit utilization of resource material in math as is typically done in other subject areas. Students located a variety of definitions in a number of different sources and compared and contrasted their findings. (See Instructional Materials List Appendix B).

In addition, Type Two math strategies included a "hands-on" concrete manipulation of fractions. Graph paper was cut by participants into 1/2, 1/4, etc. and the concepts of equivalent fractions and addition and subtraction of fractions were experienced. The abacus was utilized to demonstrate on a concrete level the concepts of number systems and place value. Students then converted base 10 numbers to base 3, 4, and 5 numbers applying what had been learned on a concrete level to the development of abstractions. Finally, calculators were utilized as a "hands-on" experience to perform arithmatical operations with percents and factorials.

Counseling Strategies - Counseling oriented strategies were concentrated for the first six hours of the thirty-hour workshop and spread out for approximately one-third of the remaining time. (See Appendix A for workshop session.) The following techniques were used throughout the workshop sessions.

1. Identifying, clarifying, labeling and reflecting feelings, behavior and thinking regarding math-related situations - Individual feelings were explored: feelings of the lack of success in understanding math; asking appropriate questions concerning math or to have questions understood and answered; communicating with math teachers; learning in general -- participant intelligence level, self-esteem, embarrassment at non-performance, self-comparisons, the blocking of math terminology, and high anxiety during math examinations; avoidance of dealing with everyday problems involving figures including money management and career decisions.

2. Questioning drawing out and evoking material for focus - Individual background material was surfaced to point up similiarities of experience as well as unique contributory factors to negative math experiences. Participants were encouraged to understand and accept how their "phobia" started by hearing about others' experiences.

3. Summarizing and reviewing important material - This was particularly necessary in the autobiography, desensitization and wind-up sessions but was employed throughout.

4. Interpreting - Surfacing the hidden meaning of behaviors which might have had their basis in a math-fear syndrome was a key technique throughout.

5. Information giving - Introduction of knowledge related to self-help, gaining insight into ones' own motivation and techniques which could be used by participants to diminish or eliminate behavior which was undesirable to them was made at strategic points in the program.

6. Initiating - A general overall plan for group goal attainment motivated and guided the counseling sessions. An awareness of each member's needs was present and a high flexibility factor was employed in group movement.

7. Reassuring, encouraging and supporting - These skills were employed in all interactions with participants, especially where aversive stimuli were present, e.g. desensitization with the rat and actual math problems. Where plans were formulated to take a future math course or when it was evident that group support was necessary, these skills were introduced.

8. Focusing/Goal setting - Group attention was focused in a supportive, encouraging way on individual concerns. Members helped other members identify, problem-solve, set goals, see options or just simply reflect on past experiences. Individual and group goals were set as sessions progressed. Short-term and long-term goals were formed as fear-laden experiences were examined and dealt with.

9. Facilitating closure - This process was employed at the end of each session as well as at the final, wrap-up session. Care was taken to urge continued group support past the leave-taking by exchanging telephone numbers and future plans to enroll in math courses with other group members.

APPENDICES

APPENDIX A

MATHOPHOBIA WORKSHOP SESSIONS AND PERSONNEL

Workshop Sessions	Personnel
Individual Pre-Testing (See Appendix B for List of Evaluative Instruments)	Psychology Instructor
Group Building & Orientation Session Building of group cohesiveness through role playing, assertiveness training and other group building exercises as well as feedback sessions between students and staff.	All Project Personnel (Described in Section C of Narrative)
Counselor Session Autobiographies Sharing of math autobiography in a group session.	All Project Personnel (Described in Section C of Narrative)
Desensitization Session Desensitization and deconditioning of anxiety in general and math anxiety in particular was accomplished through use of a white rat.	All Project Personnel (Described in Section of Narrative)
Math Session - Type One Math Strategies (See Section D of Narrative for Description)	Math Instructor 1 & Paraprofessional Counselor/Tutor
Math Session - Type Two Math Strategies (See Section D of Narrative for Description)	Math Instructor 2 & Paraprofessional Counselor/Tutor
Counselor Session (See Section D of Narrative for Description)	Professional Counselor & Paraprofessional Counselor/Tutor
Math Session - Type One Math Strategies	Math Instructor 1 & Counselor/Tutor
Math Session - Type Two Math Strategies	Math Instructor 2 & Counselor/Tutor
Counselor Session	Professional Counselor, Math Instructor 1 & Paraprofessional Counselor/Tutor
Math Session - Type One Math Strategies	Math Instructor 1 & Counselor/Tutor
Math Session - Type Two Math Strategies	Math Instructor 2 & Counselor/Tutor
Counselor Session	Professional Counselor, Math Instructor 2 & Paraprofessional Counselor/Tutor
Math Session - Type One Math Strategies	Math Instructor 1 & Counselor/Tutor
Math Session - Type Two Math Strategies	Math Instructor 2 & Counselor/Tutor
Counselor Session & Evaluation	All Project Staff
Individual Post-Testing (By Appointment) (See Appendix B for List of Evaluative Instruments)	Psychology Instructor

APPENDIX B

MATHOPHOBIA PROJECT
INSTRUCTIONAL MATERIALS

DIAGNOSTIC AND EVALUATION INSTRUMENTS

Mathematics Anxiety Rating Scale (MARS) (In experimental stages of development - not a standardized test)	Rocky Mountain Behavioral Science Institute, Inc. P. O. Box 1066 Fort Collins, CO 80521
McGraw-Hill Basic Skills System Mathematics Test Forms "A" and "B"	CTB/McGraw-Hill Del Monte Research Park Monterey, CA 93940
Myers-Briggs Type Indicator	Consulting Psychologists Press, Inc. 577 College Avenue Palo Alto, CA 94306
Otis-Lennon Mental Ability Test, Advanced Level	Psychological Corporation 757 Third Avenue New York, NY 10017
16PF	Institute for Personality & Ability Testing 1602 Coronado Drive Champaign, IL 61820
Strong Vocational Interest Blank	Stanford University Press Stanford, CA 94305
Test of "g": Culture Fair, Scale 2	Institute for Personality & Ability Testing 1602 Coronado Drive Champaign, IL 61820

PRINT MATERIALS

Basic Mathematical Skills: A Guided Approach, Carman & Carman	John Wiley & Son , Inc. 605 Third Avenue New York, NY 10016
Basic Mathematics for College Students, Stein	Allyn & Bacon, Inc. College Division 470 Atlantic Avenue Boston, MA 02210

PRINT MATERIALS (Cont.)

Basic Mathematics - What Every College Student Should Know, Hockett	Prentice-Hall, Inc. Englewood Cliffs New Jersey 07632
Calculator Activities for the Classroom (Book 2) Immerzeel and Ockenga	Creative Publications, Inc. 3977 East Bayshore Road P. O. Box 10328 Palo Alto, CA 94303
Mastering Computational Skills: Self-Help Workbook - Grade 9	Scott, Foresman & Co. 1900 East Lake Avenue Glenview, IL 60025
Mathematics: An Everyday Experience, Miller & Heeren	Scott, Foresman & Co. 1900 East Lake Avenue Glenview, IL 60025
Mathematical Ideas, Miller & Heeren	Scott, Foresman & Co. 1900 East Lake Avenue Glenview, IL 60025
Review of Elementary Mathematics, Rich	McGraw-Hill Book Co. 1221 Avenue of the Americas New York, NY 10036
Technical Mathematics, Jaffe and Maglio	Scott, Foresman & Co. 1900 East Lake Avenue Glenview, IL 60025
The Wadsworth Pre-Calculus Series (12 volumes) Carico, Brookes, Feldman	Wadsworth Publishing Co. 70 Davis Drive Belmont, CA 94002

AUDIO-VISUAL MEDIATED INSTRUCTIONAL MATERIALS

"Chisanbop" Finger Calculation Method	Chisanbop Enterprises, Inc. P. O. Box 37 Bronxville, NY 10708
Competency Skills in Arithmetic Module Five: Introduction to Fractions Module Six: Addition & Subtraction of Fractions Module Seven: Multiplication & Division of Fractions Module Eight: Introduction to Decimal Fractions	The Skills Group of the Center for Humanities, Inc. Communications Park Box 100 White Plains, NY 10602

AUDIO-VISUAL MATERIALS (Cont.)

Fundamentals of Arithmetic: A Mixed Media Program
- Module 1: Addition & Subtraction of Whole Numbers
- Module 2: Multiplication of Whole Numbers
- Module 3: Division of Whole Numbers
- Module 4: Factors
- Module 5: Introduction to Fractions
- Module 6: Addition & Subtraction of Fractions
- Module 7: Multiplication & Division of Fractions
- Module 8: Introduction to Decimal Fractions
- Module 9: Division of Decimal Fractions
- Module 10: Percent
- Module 11: Ratio and Proportion
- Module 12: Measurement
- Module 13: The Metric System
- Module 14. Addition and Subtraction of Integers
- Module 15: Multiplication & Division of Integers

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- Module 5: Properties of Whole Numbers

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MISCELLANEOUS MATERIALS

Chalkboard Protractor
Chinese Abacus
Fibre Glass Tapes, 15 meter
Kilogram Personal Scale
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Metric Measures Set
Pin Geoboard - Isometric
Tangram Math Lab Kit
Wood Geometric Solids, Secondary Set

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Texas Instrument hand-held calculators (8 digit with memory)

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